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AUTHOR	Munoz, Marco A.
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The purpose of this analysis was to examine issues of mathematics achievement in a reform environment by means of exploring the relevance of school and social variables on student performance in the state of Kentucky. The study was correlational in nature. Ordinary Least Squares (OLS) multiple regression analysis was used to identify the predictors of student achievement for the 1996 National Assessment for Educational Progress (NAEP) in Kentucky. The predictors included sets of teacher related variables (certification, coursework, and knowledge of standards), students' socio-demographic variables, and parental background variables. The dependent variable was operationalized using school scores on a standardized test, the NAEP. Student variables such as free/reduced lunch participation and race were predictors of educational outcomes. In addition, parental background variables such as father's educational level, mother's educational level, and mobility were significant predictors. Finally, only certification for the elementary math appeared as a predictor of mathematics achievement. Implications for policy and administrative practice are discussed. (Contains 20 references.) (Author/MM)

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Mathematics Achievement in a Reform Environment: The Effect of Teacher, Student, and Parental Characteristics on Student Testing Performance

Marco A. Muñoz

Jefferson County Public Schools (JCPS)

VanHoose Education Center

Accountability, Research, and Planning

3332 Newburg Road

Louisville, KY 40218

E-mail: mmunoz2@jefferson.k12.ky.us

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M. Muñoz

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ABSTRACT

The purpose of this analysis was to examine issues of mathematics achievement in a reform environment by means of exploring the relevance of school and social variables on student performance in the state of Kentucky. The study was correlational in nature. Ordinary Least Squares (OLS) multiple regression analysis was used to identify the predictors of student achievement for the 1996 National Assessment for Educational Progress (NAEP) in Kentucky. The predictors included sets of teacher related variables (certification, coursework, and knowledge of standards), students' socio-demographic variables, and parental background variables. The dependent variable was operationalized using school scores on a standardized test, the NAEP. Student variables such as free/reduced lunch participation and race were predictors of educational outcomes. In addition, parental background variables such as father's educational level, mother's educational level, and mobility were significant predictors. Finally, only the certification for elementary math appeared as predictor of mathematics achievement. Implications for policy and administrative practice are discussed.

Key Words: MATHEMATICS, STUDENT ACHIEVEMENT, NAEP, K-12

Mathematics Achievement in a Reform Environment: The Effect of Teacher, Student, and Parental Characteristics on Student Testing Performance

On March 29, 1990, the Kentucky General Assembly passed Kentucky Educational Reform Act (KERA), which mandated a complete restructuring of the Kentucky public elementary and secondary system. KERA established the right of each and every child to an adequate education based on the equitable distribution of resources (Rose v. Council for Better Education, 1989).

In Kentucky as in many states nationwide, public pressure demanding higher levels of accountability have encouraged educational, psychological, and sociological researchers to explore factors that contributed to student performance. Multiple meta-analyses have been performed to investigate the relationship between socioeconomic status (SES) and academic achievement. White (1982) investigated almost 200 studies that considered the relation between SES and academic achievement using meta-analysis techniques. Variables such as occupation of parents, education of parents, and income of family have been traditionally used as measures of SES in the analyses. Other variables such as home atmosphere (e.g., participation in cultural activities, reading materials at home, and family stability) and school resources (e.g., instructional expense per pupil, salary of teachers, and percent of teachers with master degree) have also been used extensively. Correlational coefficients have been used to analyze these relationships. The overall findings

were mixed due to differences in operational definitions of socioeconomic status.

Childs and Shakeshaft (1986) conducted another meta-analysis of research on the relationship between educational expenditures and student achievement. The researchers argue that the findings have been contradictory: (a) studies indicated no relationship, (b) studies indicated a positive relationship, and (c) studies indicated a positive relationship under specified conditions. The authors stated that, past a certain point, the amount of money a school district spends is not so vital as how the money is spent. In fact, there are multiple factors that have an influence on student outcomes:

> There is considerable evidence that non-school factors are important determinants of educational outcomes. While school is one environmental factor influencing educational performance, so, too, are the home, press, radio, television, and other cultural elements. Then, too, the outcome of schooling is affected by native ability. (p. 262)

Hanushek (1997) conducted a meta-analysis to assess the effects of school resources on student performance. Close to 400 studies were analyzed and it was concluded that simple resource policies hold little hope for improving student achievement. The researcher stated that there is not a strong or consistent relationship between student performance and school resources, at least after variations in family inputs were taken in consideration. According to this author, there is no strong evidence of systematic relationships between school

expenditures (e.g., teacher-student ratios, teacher education, or teacher experience) and student performance.

When variables other that school expenditures were considered significant, differences in achievement were observed. Cook (1984), Russel (1990), and Orfield (1994) discovered on average disparate levels of achievement between schools of different racial composition (i.e., the gap between predominately white schools and predominately Black schools). Lippman, Burns, and McArthur (1996) also provided evidence that there exist differences in achievement between schools of different social composition (i.e., high socio-economic status schools and low socio-economic status schools).

On one hand, recently, Roeder (1999) studied the performance of Kentucky schools in relationship to some academic and social variables. After controlling for several school and district factors, the author concluded that poverty was the strongest determinant of school performance. Similarly, Munoz, Clavijo, and Koven (1999) found that socio-economic status, operationalized as students on free/reduced lunch, explained 79% of the variance on student achievement of elementary schools in a large southern school district. According to Roeder (1999), the performance gaps between the most advantaged and most disadvantaged schools and between the highest performing schools and the lowest performing schools are not likely to decrease without substantial changes in the policy system.

On the other hand, lately, some studies have found that teacher knowledge and skills influence student achievement at least as much as student characteristics such as income, race, language background,

and parent education. Darling-Hammond (1997; 1999) has conducted investigations examining the ways in which teacher qualifications and other school inputs are related to student achievement across states. The analyses indicated that measures of teacher preparation and certification were the strongest correlates of student achievement in reading and mathematics, both before and after controlling for student poverty and language status. The researcher concluded that states interested in improving student achievement should attend to the preparation and qualifications of the teachers hired and retained in the profession. Fully prepared and certified teachers are generally found to be more highly rated and more successful in producing student learning gains than untrained and uncertified teachers.

In conclusion, the literature review shows that the goal of educational equity and excellence might be a very elusive issue. Some teacher variables such as teacher coursework and certification might seem important to be analyzed with other non-school variables such as free/reduced lunch and minority representation. The literature review emphasizes the importance of this study in assessing the relative impact of both school and non-school factors on student achievement. This is a relevant topic in the educational arena given the conceptualization of equity as student outcomes.

RESEARCH QUESTION AND METHODOLOGICAL APPROACH

The purpose of this study was to examine teacher, student, and parental characteristics that might have an impact on student achievement. Four grade elementary students in Kentucky were studied

to answer the following research question: What are the predictors of mathematics student achievement? The analysis was conducted on Kentucky fourth grade elementary schools. A priori power analysis was performed using the recommendations provided by Stevens (1996): n/k ratio of 15 to 1, where n equals the number of participants and k equals the number of predictor variables in the regression model.

Multiple independent variables were included in the statistical analyses. All of the data for the independent variables were obtained in the NAEP database. The predictors included sets of teacher related variables (certification, coursework, and knowledge of standards), students' socio-demographic variables, and parental background variables. The fundamental dependent variable was the NAEP mathematics test scores.

This study was a typical case of secondary analysis. The research design was quantitative in nature, specifically correlational (Gall, Borg, and Gall, 1996). Multiple regression is the recommended procedure when the researcher is interested in predicting a dependent variable from a set of predictors (Stevens, 1996). Multiple regression analysis was conducted to assess predictors of student performance. All data was entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 9.0.

RESULTS AND DISCUSSION

As presented in Table 1, six independent variables contributed significantly to the prediction of NAEP scores: a teacher variable (certification in elementary mathematics), socio-demographic variables (students race and free/reduced lunch), and parental variables (father's educational level, mother's educational level, and times changed school in the last two years). The total effect size for the model met the criterion established by Cohen (1977) for a large effect size in multiple regression. The NAEP scores for the 1996 state assessment were predicted by 26% when using the R squared. The R squared was strong in the regression model and significant at the .01 alpha level [F (17,60) = 273].

The results of the regression analyses showed that teacher certification in elementary mathematics, students' socio-economic status and race, and parental background characteristics are important factors in determining the student achievement levels of the elementary school students in Kentucky. It is important to notice that only one of the teachers' variables (i.e., teacher certification in elementary mathematics) appeared as statistically significant in the regression model.

Table 1

Regression Results on Mathematics Student Achievement (NAEP)

Standardized Variable	Regression Coefficent	Standard Coefficent	Error	T Statistic	P Value
INTERCEPT		225.1343	14.2775	15.7684	0.00000
b003501m	.1347	3.7503	1.0487	3.5763	0.00069
b003601m	.1183	3.0742	1.1320	2.7157	0.00861
b007301m	-.1484	-4.9006	1.3637	-3.5936	0.00066
b009501m	.0412	2.3442	2.3516	.9969	0.32280
drace	-.1281	-5.5306	1.6607	-3.3302	0.00148
dsex	-.0135	-.8099	2.2456	-.3607	0.71960
slunch	-.2732	-8.8505	1.4600	-6.0619	0.00000
t040501	-.0323	-4.4159	9.2496	-.4774	0.63479
t040506	.1960	7.4051	1.5767	4.6966	0.00002
t056201	-.0071	-.3235	2.7620	-.1171	0.90714
t057002	-.0347	-6.5242	6.5105	-1.0021	0.32030
t057003	.0150	2.9447	6.3504	.4637	0.64453
t057004	-.0308	-2.3030	4.4978	-.5120	0.61050
t057005	.0274	1.6912	3.8389	.4405	0.66112
t057006	-.0495	-2.9765	2.7516	-1.0817	0.28368
t057007	.0064	.3815	3.2623	.1169	0.90730
t057101	.0647	2.4195	2.3439	1.0323	0.30607

The state of Kentucky has implemented a program that addresses the social needs of the most disadvantage schools (Munoz, Clavijo, & Koven, 1999). The Family Resource Centers have been designed to address the non-school variables that might affect learning. The Family Resource Centers have the goal to enable education, social services, and health care providers to reduce or eliminate the barriers to learning (Wilson & Roeder, 1997). The idea is to create a partnership that combines state educational goals with private local companies, neighborhoods and communities' interest in developing the human capital of the future (Seeley, 1985).

KERA is an outstanding effort made by Kentucky to offer a world-class education to its citizens. According to Murphy (1991), efforts should be made to expand the "school community," to unite parents, professional educators, businesses, universities, foundations, and the general populace into a collective force dedicated to the improvement of schooling for all children. The general conclusion is that, to be successful, policies and programs cannot concentrate solely on the child, but most simultaneously address the needs of two generations -the parent and the child–for they are interdependent.

This study had several limitations that restrict the generalizability of the findings and may have an influence upon the analysis and the results. First, the population of this study was restricted to only one state, Kentucky. Second, other school and non-school variables could be included in the regression analysis that might yield different results regarding their impact on student

achievement. It should also be noted here that the order of entering the variables might affect multicollinearity (Stevens, 1996).

Further research should address new school (i.e., teacher quality, leadership, and professional development) and non-school variables (i.e., empowerment zones and enterprise communities) that affect student achievement. For example, improved teacher preparation programs, on-the-job training, and highly sophisticated recruitment need to be established to cope with the socio-economic disadvantages that our students bring to the classroom and their impact evaluated. Probably, the best teachers are needed in those schools with high number of students characterized as "at-promise" ("at-risk" in the old-fashion terminology) and we have to learn how to attract and retain those teachers. Finally, in the case of Kentucky, it is highly recommended to continue expanding the research that analyzes the degree of success of the Family and Youth Resource Centers in minimizing the social barriers to improved student performance.

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